SMITHSONIAN DEPOSIT

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Farmer's Patent Dumping Barrow.

The engraving herewith presented, represents a side view of the Farmer Dumping Barrow, which he think is destined before long to supersede the old style of barrow, when large loads are to be carried.

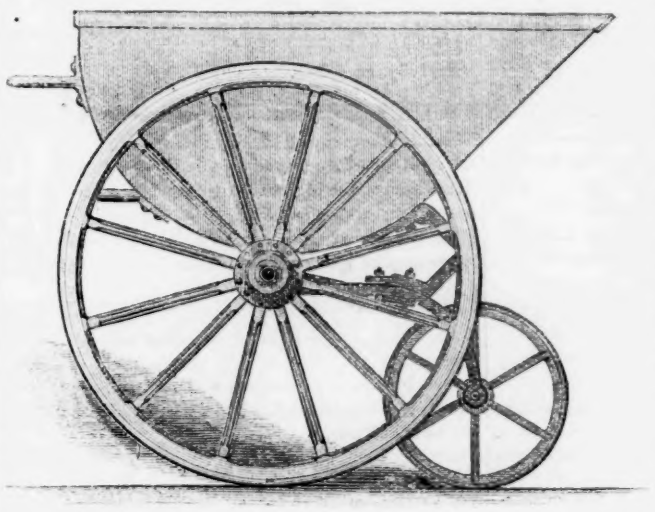
These barrows are made for one man to handle, and to carry any weight up to 750 lbs., or about three times the load that can be moved in the ordinary barrow. The load being principally carried on the two large wheels, instead of one small wheel and the arms of the man, enables the workman to move a much greater load with this barrow.

By a gentle pressure downwards on the upper handle in the rear, the smaller wheel in front is raised from the ground, and in this position the barrow can be readily turned round in any direction. By lifting at the lower handle the body will turn over on the pivots in front, and dump the load over the front wheel.

This barrow will be found to be particularly useful around gas works in removing coal, lime, coke, oxide of iron, or any other material, through the narrow passages and doors generally made in gas works. It may also be used in mines, coal yards, quarries, gardens, lime and coke kilns, and on railroads and canals.

Numbers of these barrows have been introduced into the following gas works, viz., the Manhattan Gas Works, Eighteenth street station North River; and Fourteenth street station East River, New York city; Nassau Gas Works, Brooklyn, N. Y.; Cincinnati, Gas Works, Cincinnati, Ohio; Laclede Gas Works, St. Louis, Missouri; Peoples Gas Works, Baltimore, Md.; Troy Gas Works, Troy, N. Y.; Brooklyn Gas Works, Brooklyn, N. Y., and the Worcester Gas Works, Worcester, Mass.

For further particulars write or apply to William Farmer, 111 Broadway, Room 95, New York city.



Heat and Light.

The ordinary way of considering the prismatic spectrum has been thus far, that it consists of three spectra, one calorific, one luminous, and one chemical or actinic, which overlap one another in such a way that the calorific overlaps the red and orange extremity of the luminous spectrum, while the chemical overlaps the violet and blue, and the two remaining middle colors—the yellow and green—are the brightest in the spectrum, but in compensation possess little heat and no chemical action.

Dr. John W. Draper, of the University of New York, the celebrated veteran in optical research, has recently published the results of some interesting experiments which, to a certain extent, upset that notion. It appears that he started from the hypothesis that the heat does not pre-exist in the sunbeam, but is generated by its impact on the surface on which it falls. He further considered that a wave of red light is twice the length of one of violet; but as the latter vibrates twice as fast, therefore the mechanical effect must be the same. That the production of heat by light is a pure instance of the conversion of motion into heat—an instance of the transmutation and conservation of force, and that finally, for reason of all these considerations, the heating powor of every ray must be the same whatever its color may be. He then remarks that by the nature of the prismatic refraction the less refrangible rays (red and orange) are compressed into a narrow space, while the more more refrangible (violet and blue) are exceedingly dilated, so that the heat is concentrated in the first and diffused in the latter.

By collecting the latter in one focus, and also the former, he succeeded in arranging matters in such a way as to obtain the same amount of heat from a large space of the violet, blue, and green end of the spectrum as was obtained from the much smaller red and orange. The objection may be made here that if the actinic power were the same in all the rays, it would also be more concentrated in the red rays, as well as is the case with the caloric power; but this is by no means so. In answer to this objection, Dr. Draper remarks that thus far most experiments on the actinic power of light have been confined to the substances used by photographers, namely, the haloid compounds of silver, that these are chemically affected only by the blue and violet rays, but that other substances are chemically influenced by other rays. This is perfectly correct, and it has been even proved by Baudrimont, in France, that, for instance, by the chemical action of light on the leaves of plants the red rays play a most important part, so that plants need all the natural undiluted sunlight, proving the fallacy of a theory of General Pleasanton that blue light would stimulate and promote vegetable and animal growth—a theory according to which he constructed hot-houses, etc., in which the solar light was deprived of its red and yellow rays by passing it through blue glass, and for which he even obtained a United States patent. In the meantime Dr. J. W. Draper's theory and experiments do not disprove the fact, that in the dark space beyond the red of the spectrum the greatest heat is found, while at the other extremity in the dark space beyond the violet, chemical action possesses so much intensity that this space can be photographed with all its invisible lines, notwithstanding the invisible rays are here exceedingly diluted. At the other extremity, beyond the red, notwithstanding the compression of all the rays into a narrow space, no such photographic impressions can be obtained, no matter what chemical preparation is used.—*Dr. Van der Weyde.*

The "Ellis Vapor Engine."

A letter from the Haskins Machine Company, of Fitchburg, Mass., forwarded to us by the inventor, states that the system has been introduced into the works of that corporation with every success. The machinery of the establishment is operated by a six by nine steam engine under a pressure of 65 lbs. With the exhaust from this engine the bisulphide of carbon is boiled, and with its vapor a second engine, of eight inch cylinder by eleven inch stroke, is actuated. The power is not only applied to the immediate use of the factory, but is conveyed by means of a 254 foot wire cable to a neighboring establishment. For this service the company receives a sum about equal to that which it costs to produce the steam for the steam engine, so that which would otherwise be clear waste is here turned into gain. It is further stated that the vapor engine, when once in complete order, worked with literally no stoppages other than were desired, and that the total leakage, for a period of over four months, was less than one gill per 24 hours. At the expiration of the whole time in which the machine was in continuous use—about eight months—the manufacturers, desiring to replace it with one of newer and more improved form, sold it for cost price, a careful examination of all its parts by the purchaser proving that no portion had become deteriorated or injured.

As regards the bisulphide of carbon employed in the boilers, we learn that the Vapor Engine Company have erected works for its manufacture, and are prepared to furnish it to consumers at one dollar per gallon. The same concern also supply the vapor engine with their fixtures, etc., in all sizes, and guarantee that a combined steam and vapor machine will give a certain horse power, with half the fuel required to produce the same power with the steam engine alone. —*Scientific American.*

Cheseborough's Scheme.

Another new American idea, which proposes to prevent canals from freezing Mr. Robert A. Chesebrough, a scientific New Yorker, has published a pamphlet giving full details of his plan for keeping the canals open during the winter by the introduction of artificial heat. Startling and impracticable as the proposition first strikes us, we are far from pronouncing the scheme impossible, or even visionary: and if the thing can be done, the importance of the invention can hardly be estimated in figures. It is a well-known fact that a body of water freezes only on the surface, and that it begins to freeze at 32° Fahrenheit. Mr. Chesebrough proposes, by the insertion of a pipe filled with hot air running along the inside of the canal, to keep the water on the surface a degree or two *above* the freezing point.

If this can be done, the problem is solved, and we shall hear of no more commercial constipations by the closing of canals in winter.

The great Erie Canal, for instance, which connects the Hudson River with Lake Erie, is closed for several months in the year, and not unfrequently with millions of dollars' worth of produce locked up *in transitu*. In 1871 the canal transportation exceeded that of all the railroads. During the winter of 1871 no less than four hundred boats, containing three and a-half million bushels of grain, were frozen up in the Erie, the freight on which amounted to $640,000. Were it not for the ice embargo there would be a very great extension of the canal system in the Northern States. The Erie Canal would be extended to the town of Erie, where it would connect with the Pennsylvania Canal; thence to Cleveland, where it would connect with the Ohio Canal; thence to Toledo where it would meet the Miami and Wabash Canals: and thence across the peninsula of Michigan to Chicago, where it would be united to the Mississippi River by the Illinois Canal.

No one can for an instant doubt the vast importance of Mr. Chesebrough's scheme. The only way to silence scepticism is to make an application of the theory on a small scale. If it prove successful, the inventor will have no trouble, even in panic times, in raising millions, if required, to keep all the canals, if not all the rivers, of the North open all the winter.

The annual cost, as applied to the Erie, 350 miles, is estimated at $611,275—a mere bagatelle in comparison to the loss of freight receipts during the five or six frost-bound months of the year.—London *Cosmopolitan.*

A Simple Fire Alarm.—Dr Van der Weyde suggests that the cheapest, most simple, and practical fire-alarm for ordinary household purposes, is a small weight of lead or iron made to adhere to the ceiling of each room with a piece of wax. When the temperature becomes elevated above that of the ordinary atmosphere, the wax will lose its adhesiveness and allow the weight to drop. The weight can be attached by a wire to all the bells in the house, or to sound any alarm extemporized for the purpose. The weights should be kept away from stove-pipes and out of the sun, and one should be placed in each room and hallway. They will not fail to give the alarm when there is an excessive increase of temperature, and no house should be without them. This alarm is not patented, and is free to be used by all without money and without price.

Chemical Repertory.

No. 105.—January 2, 1874.

EDITOR—HENRY WURTZ.

CHEMICAL EXCERPTS.

949. Causes of Rusting of Iron.—De Hutten.—Oxygen and carbonic acid do not produce rust unless dissolved in water. Rusting does not cause the formation of ammonia, though that compound may be produced at the same time. Alkaline solutions prevent rusting until all the alkali is converted into bicarbonate.—*American Chemist.*

950. Indicator of Vitiated Air.—A solution of palladium chloride is so connected with a battery, that as long as no metal is precipitated, no current passes: but as soon as carbonic oxide occurs in the atmosphere, metallic palladium is precipitated, which establishes a current, and rings a bell to give warning of the presence of the noxious gas.—*Ibid.*

951. Spectrum Investigations.—We have before had both the following two items im different shapes, though probably not so good as here:

Hydrogen.—M. Salet obtained from hydrogen only one spectrum, that with three bright lines discovered by Angstrom; these lines being capable of enlargement, more or less, according to the temperature of the discharge. With M. Angstrom, he attributes the two other spectra which M. Wullner obtained with hydrogen, the one to acetylene, the other to sulphur. No other spectrum of absorption was obtained from this gas than that furnished by the atmosphere of the sun and of several stars. The author was unable to obtain a discontinuous spectrum by the combustion of hydrogen in oxygen or in chlorine: the spectrum was always complete.

952. Sulphur.—M. Salet also reports the following: The introduction of a certain quantity of sulphur into the hydrogen flame produces, in the portion of this flame having the highest temperature, a bluish-violet coloration, which, studied with the spectroscope, gives the primary spectrum of sulphur. The colored space may be considerably increased by pressing the hydrogen flame against a sheet of water; the entire surface of contact becomes colored with this blue light, which can then be spectroscopically analysed. The author considers that by this process one may detect, by simple coloration, without using the spectroscope, the presence in a hydrogen flame of 0.000002 grains of sulphur.

953. British Patent—Preserving Meat.—Metge and Vuibert, of Boulogne-sur Mer, France, February 26, 1873. This invention relates to a method or process of preserving meat in bulk in its fresh, uncooked condition. The animal is killed by felling, and immediately skinned and cleaned. It is then glazed over with a preparation of sugar and alcohol and placed in a bed of fat. The case is exhausted of air and soldered up.

954. British Patent.—Candles, Matches, and Lamp for Burning Candles—W. J. S. Grawin, Paris, February 24, 1873. This invention relates to the application of naphthaline. (1). As a substitute for sulphur, wax, resin, or other inflammable materials used for dipping or impregnating matches and firelighters. (2). As an addition to the phosphorus paste in which the ends of wax and other matches are dipped. (3). To increase the inflammability of candles, tapers, links and torches. (4). For burning in lamps in the form of a hollow candle, provided with an independent wick and double air current, the flame serving to melt the solid naphthaline to feed the wick.

955. Arkansas Coal.—This State can, without exaggeration, boast of her mineral deposits, especially when we take into consideration the various parts, their general rich quality, and enormous quantity. Here are magnetic, hæmatite, specular, calcareous, and other varieties of iron ore, lead, zinc, and coal, manganese and associate metals, together with marble, gypsum, salt, kaolin, whet and hone stone, slate, limestone, granite, marl, paint, and nitre earth. The coal fields of the State embrace an estimated area of 12,000 square miles, and in the valley of the Arkansas river, where the most coal mining has been carried on, the beds are from four feet to nine feet thick. This coal is similar in structure and appearance to the Cumberland coal of Maryland, and its quality, by analysis, is very similar. It is also an excellent steam and manufacturing coal. The Arkansas river runs for 150 miles through this coal formation. The advantages that Arkansas possesses in this respect must shortly enlist the attention of coal mining capitalists of the Eastern States.—*Iron.*

967. The Erie Railroad Company in the Coal Trade.—The Erie Railway Company are going into the coal business. They have already obtained control of over two thousand acres, the greater part of it in the Lackawanna Valley. Engineers are already surveying a branch line from the main line to the coal fields. They have been large consumers of coal, as the records for the past year will show: Anthracite carried 2,381,985 tons, as follows: from Hawley 1,300,799; from Honesdale, 599,763; from Carbondale 405,886; from Binghampton 75,537; anthracite and bituminous from Waverly 439,268; bituminous from Corning 627,391; and from Alton 1,825 tons.—*Coal Trade Circular.*

957. British Patent.—Method of Photometric Measurement.—Webber, February 24, 1873.—This invention relates to a method of and apparatus for obtaining photometric measurements in terms of electrical measurement. A body, of which the electrical conductivity or resistance is altered by exposure to light, is placed in an electrical circuit, in which circuit is also placed an electrometer or gauge of electrical resistance. Light is directed on the body, and the value of this light, or the transparency or density of any translucent substance through which the light is passed is tested by the effect on the electrometer or resistance gauge.

958. Coal in Lincoln, Cal.—The lignite coal miners at this place have now commenced work in earnest, and are erecting costly hoisting works. The machinery is all on the ground, and also the lumber to erect a building twenty-four by sixty feet. That there is a bed of lignite coal here in large quantities is a demonstrated fact, which has been proven by boring in six different places, the holes being bored from one to three hundred feet apart, and the coal being found in each from eight to fifteen feet thick. The coal is superior to anything before discovered in this State outside of the Mount Diablo mine, which it resembles very much. It will take about two weeks to get the mine and machinery in working order.—*Scientific Press.*

959. Petroleoducts.—Iron pipes are beginning to take the place of railroad transportation of oil. The new pipe line in process of construction between Millerstown and Raymilton, Allegheny county, is being rapidly pushed to completion. The pipe will be three-inch lap-welded tubing, and will be twenty miles in length. It will be fed by Vandergrift and Forman's two-inch lines, which are connected with the wells in all parts of the Butler district and will be of great service in opening up a new outlet *via* the Lake Shore and Michigan Southern to Cleveland and the seaboard. It will have a pumping capacity of 30,000 to 35,000 barrels per day, and will cost about $8000 per mile. It is expected to be in running order by the 1st of November.—*Iron.*

960. British Patent.—J. R. Harper, Clerkenwell, London. Improvements in gas lamp blow-pipe apparatus, part of such improvements being applicable to either oil and spirit lamps.—These have for their

object the conbination of a current of air with the jet of ignited gas or vapor as it issues from the oil or spirit vessel. The jet pipe is surrounded by or enclosed within another pipe open at each end, so that when the jet of gas or vapor is ignited a strong current of air is caused to enter the pipe behind the jet of ignited gas, an additional jet pipe is employed to evaporate and maintain the pressure in the oil or spirit vessel, which is surrounded with a water or steam jacket. The safety valve is surrounded with a case to receive the gas and conduct it to the jet tube. Gas blow-pipe apparatus is enclosed in a central chamber formed within an annular chambered oil or spirit can or vessel containing a supply of benzoine, paraffine, or other cheap oil or spirit.

961. Ingenious New Balance.—Prof C. Pickering, of Boston, with whose name our readers are familiar, has patented an invention thus described: The object of this invention is to produce, for the purposes of scientific investigation and the use of the public in general, an improved balance, which consists in arranging a spirit level and adjustible weights with one end of a scale beam carrying a weighing pan at its opposite end. All the weights, large and small, are put on the scale pan, which will then balance the weight of the beam, so that the bubble of the level will come to the center of the tube. If not, a loose nut is adjusted till the exact balance of the weight is obtained. The body to be weighed is then placed on the pan and the weights removed gradually until the bubble is again in the center. The weights removed are equal to the weight of the body. The weights may also be taken off and added in the usual way till the beam is again horizontal. Those remaining give the weight of the body.

962. High-pressure Filter.—We saw the other day at Manchester, one of Clemesha's self-cleansing filters. These are made for attachment to the ordinary water main, or the supply pipe from a cistern or reservoir. A regulator forms part of the filter, by which the character of the water can be controlled. This is in the form of a dial, the hand working a tap, which allows water to flow in various directions, so that unfiltered or filtered water may be obtained a pleasure, or the animal charcoal composing the filter may be cleansed. They are not troublesome to work, simply requiring to be fixed to a supply pipe and not interfered with, except for cleansing. Thus in large houses and public institutions the filter can be attached to the main where it enters the building, and filtered water can be drawn off at any place. The water runs through the filter quite as rapidly as though nothing had been interposed in its course, and it is singular to see peaty water running from one tap, and the same water after passing through the filter issuing perfectly colorless. It is claimed also that the scaling of steam boilers may be to some extent prevented by the use of these filters, which are made by Mr. Joseph Halliday, of Newtown, Manchester.—*Iron.*

963. Interesting English Patent.—J. G. Tongue, 34 Southampton Buildings, Chancery Lane, London. Improvements in musical instruments named the "pyrophone." The pyrophone is an improved musical instrument of the description known as the chemical harmonicon. It is well known that when a pure hydrogen gas jet burns in a glass or china tube or other vibrating material a pleasant soft tone or sound is produced. The characteristic novelty of this improved instrument consists in the construction of the burners, and in the combined apparatus employed to act on these burners by means of the touch on the keys similar to an ordinary piano, in order to obtain the sound or note required, or to stop it instantly as required. The burners are constructed with double oscillating branches in such manner that the two jets are brought into one by the contact of the two arms or branches, whilst at the moment the sound or note is produced the two branches are separated and form two distinct jets, which produce the vibration and consequent sound in the glass, china, or other tube which surrounds the branches of each jet or burner. These improvements in the construction of the pyrophone consist (1) in dispensing with the inlet cock for the gas;)2) in the means employed for dispensing with the two cocks heretofore employed for regulating the passage of gas to the two branches of each tube; (3) in a more simple arrangement of mechanism for transmitting the movement of each key to its two corresponding branches.

964. Petroleum for Fuel.—At a meeting of the American Institute, December 18, Mr. D. Merg exhibited a plan to economize fuel by burning petroleum instead of coal or wood. His plan was to have a pan of water, in place of the present grate-bars, under a boiler, the petroleum to enter the water below through a pipe leading from a tank, which might be remote from the fire and enclosed also in water to prevent accident. The petroleum would float upon the surface of the water by its own specific gravity, and when ignited the flame could be intensified by the introduction of a jet of steam from the boiler. He had been using this plan in his factory for nearly a year, at a saving in the cost of fuel of about 50 per cent.

965. Water Famine in the West.—Davenport, Iowa, Dec. 18.—The drought in Iowa this fall has been something unknown for years. The Mississippi has been very low; at Keokuk lower than ever before was recorded. The farmers, whose wells and springs have failed, have had to draw water many miles for their families and cattle. A great number of wells have been begun and abandoned, water not having been found even after reaching extraordinary depths. The railroads have suffered severely. The Northwestern road has been compelled to run water trains up and down the line to keep the regular trains supplied, something unparalleled in railway experience. On the Des Moines Valley road not a drop of water has been obtainable on one stretch of sixty miles. Light passenger trains have been able to make the run with a tender full of water, but engineers of the freight trains have had to leave their trains midway and run up or down for water to finish the trip. But for the recent heavy rains the loss this winter would have been serious.—*Daily Paper.*

The Manufacture of Gas from a Mixture of Tar-Oil and Dross.*

Read to the West of Scotland Association of Gas Managers, September 26, 1873, by Mr. Foster:

Mr. President and Gentlemen.—The subject of this paper—viz., "The manufacture of Gas from a mixture of Tar-Oil and Dross"—is one that I would have wished had been placed in more able hands, for this reason—any subject treating on the producing of gas at a cheaper rate than the present system is all engrossing, and would require to be ably handled. Two years ago gas managers, with very little care or trouble, could make gas and sell it at a cheap rate, and still have a good balance on the right side of the ledger; but times are changed, and it will require very fine manipulation to make ends meet at the end of the year. If by this or any other means we can keep down our coal account, it will be better for our shareholders, the public, and likewise ourselves.

This tar-oil, as it is called, is the product remaining after the paraffine oil has been taken off. It much resembles coal tar in appearance, but smells strongly of paraffine.† I am told it can be got in large quantities at any paraffine oil works.

It is now about six months since I commenced to use this mixture, during which time I have tried it in every possible manner; and up till within a fortnight ago, I used rather more than 75 per cent. in the producing of gas for lighting the town of Portobello. From statistics which I will submit to you in this paper, you will be able to judge for yourselves the benefits to be derived from using it.

The first experiment I made I had 17 cwt. of limerigg dross and three cwt. of tar oil. The results were—

Gas from mixture	10,100 cu. ft.
Durability of 1 c. f. with 5in flame	55 min.
Illuminating power of 5 cu. ft.	27·50 candles.
Value of 1 cu. ft. of the gas, sperm	660 grs.
Weight of coke	1,338 lbs.

Cost of Material.

17 cwt. of limerigg dross, at 13s. 6d. per ton, 11s. 5d. Three cwt. of tar-oil, at 30s. per ton. Total, 15s. 11d.

According to this analysis I had upwards of 27-candle gas at a little over 1s. 7d. per 1000 cubic feet. This, of course, does not include labor, nor any expense connected with the manufacture.

I found, however, in this experiment, that 3 cwt. of tar to 17 cwt. of dross was rather wet, and brought down the heat of the retorts; I, therefore, in my next trial, used 20 cwt. of dross and 3 cwt. of tar, and I found this mixture work so well I have never changed.

Gas from one ton of this mixture	10,500 c. ft.
Durability of 1 cu. f. with 5in. flame.	50·25 minutes.
Illuminating power	24·30 candles.
Value of 1 c. f. of the gas in sperm	585·36 grs.

According to this analysis I had nearly 24½ candle gas, at 1s. 8d. per 1000 cubic feet. In all my experiments during the last six months, and they have not been few, the results were—

Maximum quantity, per ton	10,700	cu. ft.
Minimum " "	10,000	"
Average " "	10,350	"
" Illuminating power	25	candles.
" Durability 5-in. flame	52	minutes.

The above experiments were all made in the ordinary way of working, six clay retorts being used, 8 feet long by 14 inches diameter; weight of charge, 1¾ cwt.; time taken in carbonizing, from four to four and a half hours.

The coke produced from this mixture, if a caking dross be used (such as limerigg or blackband), is very valuable, and I can command a ready sale for it, at 20s. per ton, for using in the furnaces for heating the retorts. Nothing in the shape of coke I have ever seen can beat it; and it is much more durable than the coke produced from cannel coal, thereby leaving a larger quantity for sale, and entailing less work in connexion with the furnaces.

This tar contains merely a trace of sulphur, therefore its action on the purifiers is very easy.

Mr. Boyd McRae (Dundee), in his very able address at the late meeting of the North British Association of Gas Managers, held in Edinburgh, impressed on the meeting the great necessity there was for gas managers taking the greatest possible amount of gas from the coal, thereby economizing coal. If this were done less coal would be required and the demand lessened, for it is owing to the great demand and the diminished output that has caused cannel coal to advance to such enormous—shall I say extortionate prices? If, while doing this, we gas managers were to use a proportion of this mixture, suppose it were only 1-10th or even 1-20th our yearly quantity, it would greatly assist in keeping down the demand, and I am confident in stating would show good results on the balance sheet at the end of the year.

Gas companies in England and other places take yearly from Scotland large quantities of cannel coal for enriching their gas. I am perfectly convinced if they were using this tar-oil in the proportion of 1 to 20 it would bring up their illaminating power from 12 candles, the average production of their coals, to 16 candles, which is, I believe, their average standard.

I would ask that every gas manager at this meeting give this a fair and impartial trial. You do not require to alter any existing arrangements to do so, and the cost for the quantity of material would be a mere trifle. All that would be required for a trial would be 1 ton of dross and 3 cwt. of tar oil, any quantity of which can be got at any paraffine oil-works at not more than 1s. 6d. per cwt. Mix the tar and dross in-

* What we call slack.

† Paraffine has ng smell.—Editor Amer. Gas-Light Jour.

timately the one with the other, and charge in the usual way, taking care not to charge too heavy, and in as regular a layer as possible in the retorts, and not work your charge too long.

I may state that I am not the only one who uses this mixture; Mr. Cusiter (Dalkeith) and Mr. Scott (Musselburgh) have used it very successfully for the last two or three years, and both parties analyzed it very minutely, and their results are even better than those stated by me.

There are many points I have purposely left out in this paper connected with this subject which I think may be better brought out in discussion, as I consider that more information can be got in a meeting of this kind in that way than could be gained by the most elaborate of papers. I can only state that any information or explanation that I can give is entirely at your disposal.

Mr. Learmont said he had tried this plan on a small scale in the proportion of 1 ton of dross to 3 cwt. of tar-oil. The quality he had found quite up to the mark quoted by Mr. Foster, but he had to employ seven retorts instead of five, so that for him it was quite unsuitable. The coke, too, came out small and fell through the bars of the furnace, and was therefore of no use.

Mr. Key: Do you mean by using more retorts that it took too long a time to take the gas off by this process?

Mr. Learmont: The charge lying so close prevented the heating up of the retorts.

Mr. J. Renfrew: I have used this method with half a ton of dross and 2 cwt. of tar-oil. In my case, as in Mr. Learmont's, the dross came out in ashes, and, instead of from two to two and a half hours, four and a half hours were needed in running the charges. There was also a difficulty in putting on the lid of the retort on account of the flames, which was the chief cause of my giving it up.

Mr. Hunter said he had used ordinary coal tar mixed with sawdust, but had no apparatus to test the quality, and had obtained double the quantity per ton than from the gas coal, experiencing the same difficulty in putting on the lids, and had to desist on account of the choking of ascension-pipes.

Mr. Renfrew remarked that his ascension-pipes choked every charge.

Mr. Clyde (Largs) said that nine or ten years ago, when M'Kenzie's patent was taken out, he went to see it working. Various kinds of dross was used, but no matter what it was, it came out of the retort as small as it went in, except that from one pit alone, near Paisley. Soft coal brought from England made a good coke. He could state that even with the oil and dross the gas wos nothing like what was made from cannel coal, and if everything was considered, the expense for tar-oil would be equal. He was referring merely to M'Kenzie's patent. The experiment lasted for three or four days.

Mr. Jeffrey: I have tried both M'Kenzie's patent and "Greenshield's method." Dry ashes were left in the retort in the first case, but in the latter the coke was all in one piece, so that the result depends upon the kind of of dross used; 27-candle gas was expected, but I only got 22.

Mr. Cusiter (Dalkeith): For the last four years I have wrought this tar-oil and dross, and have had no reason to regret it, and the results have been very similar to those given by Mr. Foster. It is possible to use a non-caking dross, but if it has no such inherent tendency the oil will not impart it. I have also mixed it with sawdust and obtained a large quantity of gas of good illuminating power, but, of course, worthless coke. In reply to Mr. Key, he added that he had found no greater difficulty, with the mixture as to choking in the ascension-pipes, than with cannel coal. This evil could be prevented very much by using a small dip in the hydraulic main and by keeping the mouthpieces clean. It was from these that the mischief chiefly arose, althoug the richer the material the greater the tendency to choking, still he held the mixture had no greater tendency than coal.

Mr. Hall: Do you use an exhauster?

Mr. Cusiter: I am not using an exhauster.

Mr. Scott (Musselburgh): Some members have found a difficulty in keeping up the heat of their retorts with the mixture, but the remedy for this is very simple. I use one-third of the mixture along with cannel coal, and the retorts work off at their proper time.

Mr. Foster: I have used the tar-oil with a bad caking dross, with the bad results referred to. Like Mr. Scott, I have used the mixture along with parrot coal. Another way to effect the same object is to leave in half of the coke, and charge rapidly on the top. In this way you can charge every two hours, and get good success. Of course the flames are pretty strong for the stokers.

Mr. Hall suggested that another difficulty might be that, in case of tar-oil being in demand for this purpose, it would rise in price, thus rendering the process as expensive as the other, and remarked that no good caking dross was to be had from the pits in this locality.

Mr. Foster: I find that the gentlemen who have already spoken have answered the objections proposed, just as I would have done. I find no trouble in the matter of choking, and have also a good coke.

The President, referring to Mr. Foster's statistics, said that the results seemed to be very good, the chief difficulty being the extra expense of procuring a proper dross in this locality.

A vote of thanks was accorded to Mr. Foster for his paper.

[The above experiments will doubtless remind the profession of the method of McKenzie (with slack and petroleum ground up together, tried in 1868 bo the lamented Sabbaton with such excellent results. Now that petroleum is worth but one third what it was then, Sabbaton's experiments ought to be repeated. —H. W.

[Original Communication.]

Some Notes on the Chemistry of Gas Manufacture.

By Augustus A. Hayes.

[Continued from page 208, December 2.]

My intention in former notes has been mainly to show that coals are as varied in composition as are the beds distinct in position, and that coals have their origin from different organisms. Probably some coals are formed from humic matters, which have advanced in decay nearer to pure carbon before solidification, through the loss of hydrogen compounds, as we see in anthracites. All correct observations go to prove that the kinds of coal do not pass into each other, through changes in their constituents, after the coals have been solidified.

In the technical consumption of coals, we select those having special adaptations to special use, so far as market facilities allow; but there are controlling powers and influences within the reach of the chemist, which enable him to substitute one coal for another in applications of the highest importance. Thus anthracite in some varieties produces very little visible flame, but the addition of a little steam to the air continuing combustion, renders it a flaming fuel. Coals which usually produce only compact, dense coke, when thoroughly wetted and suddenly heated afford porous, easily ignited coke. Two coals in mixture afford varied products, from those of each separately decomposed.

In the important manufacture we are illustrating, the choice of the material for producing gas has been influenced by adaptation, abundance of supply, price, and to some extent "old custom." Where choice of varieties is permitted, mixtures can be continuously so adjusted as to enable the gas engineer to obtain a given standard of gas, usually. This choice is always founded on *the characters of a given coal, under the influences of heat in closed vessels.* Entirely apart from the use of coal as fuel, or in other applications, the art of manufacturing gas is founded on separating the normal constituents of a coal, that they may in the same space combine anew, to produce gaseous bodies: a small portion of aqueous saline fluid, and carbon.

In practice several compounds besides those sought for are produced. The hourly presence of these bodies has led to some misconceptions regarding the composition of coals, which may be easily explained and removed. The term *bituminous*, as applied to coals, doubtless arose from the offensive tar-like adhesive bodies *formed* by heating them. We do not call beech wood, nor wool bituminous, yet they both yield similar bodies. A common sense view of the matter is, that heat eliminates these various bodies from coals, as pre-existing compounds. Now *science* is "refined common sense," and science proves that *bitumen does not exist in coals*, and goes further in demonstrating fully, that the basis matter of coals, varied as they are, is not complex in composition. It is truly difficult for the unchemical mind, having the evidence of eyes seeing tar-like bodies flowing from heated coal, to believe that the coal did not contain them: it is necessary to a clear understanding of all that will follow, that the mind of the reader should be cleared of this error, and rest on the fact, that the heat applied to the coals, produces from their basal compounds, not previously formed bodies, which it *educes*, but new bodies arising from chemical reactions, which it *produces*, in accordance with laws of great influence and beauty.

Thus in coal beds there is a constant change of composition going on:—gaseous matter identical with the basis of illuminating gas, escaping from the coal. That part of the coal which we change into gas by heat, is here converted into gas at a natural temperature. The coal even in its solid state is passing to more carbonaceous compounds, in the time that the less carbonaceous matters are being formed and are passing off, as we see roughly in a heated gas retort. All hydrocarbons, especially under the influence of heat, tend toward this change. If we put on a watch glass some pure gasolene, it will diffuse in the atmosphere at 60° Fah., and leave no trace behind it. But put the same gasolene into a retort of thrice its volume, apply the heat of boiling water: a portion of the fluid will be vaporized: soon after no vapor will form, and finally a more dense, more carbonaceous fluid will remain, requiring more than 300° Fah. to volatilize it, instead of 60° Fah. at first. Even the low temperature of 212° Fah. has brought into action the same law which applies in the gas retort, the slightly oxidized hydrocarbon coals being substituted for gasolene.

When we separate as far as we are able, the basis matter of a very uniform coal, we find it to be an excessively finely divided matter, of a dark brown color, impressible, somewhat elastic and pliant; insoluble in most agents, having no oily, resinous, or bituminous character whatever—in fact a simply constituted humic compound, indifferent to chemical agents but easily affected by heat.

It is to this relation to the simple application of heat, that we are indebted for the products not only of gas manufacture, the coke of the coke ovens, but for the almost infinitely varied, complex and beautiful colors and pigments, which have added to our enjoyment of taste and entered into high art. The extension of chemical science has been largely due to this reaction among the constituents of coal induced by heat, and the course of commerce, and the changed employments of large numbers of people may be referred to an extension of our knowledge of the mode of action of heat on the constituents of coal.

MIXTURES OF COALS.

Experience has demonstrated the advantages arising from consuming a mixture of coals in the production of gas. The practice seems to have grown up and extended on the obvious suggestion, that the gas of a poor quality of coal may be rendered more luminous by the addition of a portion of coal producing more illuminants, in making up the retort charge. Generally speaking, this result follows—but the sug-

gestion arises as a question: Will a coal producing thirteen candle gas mixed with a coal producing forty candle gas, in the proportion of equal weights, afford a gas of twenty-six and one half candle gas? Thus 100 lbs. = 13; 100 lbs. = 40 = 200 lbs. = 53 or 100 = 23–5? We may suppose there are many who can reply to this question through personal knowledge, but unfortunately there is little record: the practice seems to have been to add the rich coal in proportion to produce the desired candle power in the resulting gas. My own experiments demonstrate that every mixture has an economical point, on either side of which we pay for more enriching coal than the return warrants. Using the Picton coal as a basis coal, the addition of regulated percentages of Albert coal did not give the same simple proportion of increased light, as was due on the calculated proportion. A series of trials of other chiefly American coals confirmed this result. Some Ohio cannels mixed with other Ohio common laminated coals, gave gas which proved decided economical points in various mixtures. When the proportion of enriching coal was above a certain amount, the gas produced did not increase in luminosity so much as the amount of coal was increased: the general result was as stated, that certain proportions must be observed, if we would obtain the best economical results of mixing coal of known qualities. In one or two instances the departures were so wide from the expected value in candle power, as to prove that most varied reactions take place in the retort, when the constituents of divers coals are similarly acted on by heat.

The safe practical course here is experiment under the conditions of the gas works, when mixtures in different proportions of well known, as well as unknown qualities, are to be consumed.

Besides influencing the quality of the gas, mixed coals, as might have been supposed, produce varied secondary products in the ordinary workings. Thus, a coal which alone affords a large quantity of naphthaline will not afford a *pro rata* proportion when mixed with a coal which produces paraffine. This fact has an important practical value in its bearings on the choice of coals.

The production of naphthaline by certain English coals, largely consumed in the manufacture of gas, has given rise to an opinion among gas engineers, that it is always a notable product, whose characters are not favorable to ease in the management of the gas produced—a *bete noir* in fact—which opposes mechanical purification, and adds to the difficulties attending the manufacture and distribution of gas. It is so common in certain districts to find the belief existing that coals, all coals must produce a large amount of naphthaline, that one is obliged to seek in the truly local experience of the engineer, the influence which has established an error. In further illustration of this important point it affords me pleasure to use the words of a correspondent of this Journal, No. 347 (E. S. Cathels)* "that the same temperature that produces napthaline freely from the carbonization of Newcastle coal, produces much less of it from lumpy and pebbly inland coal—as I have practically proved." The fact of the production of naphthaline by some coals largely, while other coals afford no considerable quantity, under the same influences of heat, has not been insisted on; its bearing here is in proof that with freedom of choice, the manufacturer may throw into his retorts the materials which in decomposing, will or will not afford naphthaline. In proceeding we shall give further illustrations based on experience.

[To be continued.]

A Sad Case.—On the evening of December 22nd, Edward Schwarz Voegel, his child and wife, were found in their room at a hotel in Cincinnati, Oeio, the two former dead and the latter in a dying condition from inhaling gas, which they had neglected to turn off before retiring.

* On this interesting topic of naphthaline, we have just in hand an important new communication from Mr. Cathels, unfortunately too late for this issue.—Ed.

Correspondence.

[Correspondents, in all cases, should sign their communications with their names and address in full—not necessarily for publication, but as a guarantee of good faith.—Ed.

Combination of Hydrogen Gas and Carbon.

Jacksonville, Ill., Dec. 9, 1873.

Mr. Editor: The frequent new patents, or revivals of old patents, founded on the hypothesis that hydrogen gas can be combined with carbon, forming a hydrocarbon, leads me to ask these questions.

Can hydrogen gas and carbon be united except by *vital forces?*

Has it ever been done?

Permit me to make an extract from "Clegg on the manufacture of gas." The article is by Dr. Frankland, F.R.S., F.C.S. After speaking of the effect of heat in combining carbon with oxygen, he says:

"The affinity of carbon for hydrogen appears to be affected by heat in a manner directly opposite.

"With one or two exceptions, which are not of the slightest importance to the gas manufacturer, we know of no artificial process by which a union of these elements can be produced. When brought together they do not exhibit the slightest tendency to combine at any temperature to which we can subject them.

"It is only by the agency of the vital force exerted in the tissues of animals and vegetables, that the union of these elements can be effected. We are therefore indebted to animal and vegetable organisms for every particle of hydrocarbon that has ever existed.

"When, however, any compound of these two elements, formed as above described, is submitted to an elevated temperature, the uniting force always appears to decrease as the temperature increases. Thus, the more condensed hydrocarbons, as olefiant gas, naphthaline, etc., are decomposed at a red heat, depositing a part of their carbon, and being converted into light carburetted hydrogen, which last, at a somewhat higher temperature, is entirely resolved into its elements, carbon and hydrogen.

"These two facts—the necessity of vital force for the production of hydrocarbons, and the diminution of the affinity between carbon and hydrogen by increased heat—are of the highest importance to the gas manufacturer.

"A knowledge of them would have entirely prevented the expenditure of so much trouble and capital in those numerous futile contrivances for increasing the illuminating power of gas, or, in other words, increasing the quantity of hydrocarbon by passing it through red hot retorts, etc., filled with coke, plumbago, and other carbonaceous materials. It is utterly impossible that any union of carbon with hydrogen can take place under such circumstances."

If the position taken here is true, a knowledge of it is of vast importance to the gas interests. I for years have had no doubt on the subject. All patents for processes which claim to combine hydrogen and carbon (and there have been many) have utterly failed, and must fail until there is some new and important discovery in chemical science.

Yours respectfully,

J. O. King.

[Editorial Note.—In the edition of Clegg, that we happen to have at hand (the 4th, 1866) we are unable to find the above passage, which may have been interpolated in a later edition; though we believe that even in 1866 it was known that carbon and hydrogen can be combined without vital action, and that *acetylene*, for example, may be formed by merely bringing them together at an intense heat. Mr. King is perfectly right, however, in his opinion, and Dr. Frankland in his statement, that, so far as any *practically* valuable results are concerned. Such attempts to combine the two elements *are* futile, upon any principle as yet known to chemists. We regret, however, that Mr. King has not been more definite in the way of statement as to what new patents he refers to. His obscurity in this regard is total, and will probably defeat his object, which, we presume, is similar to our own, to arouse useful discussion. We feel impelled, therefore, to beg from our correspondent—now that we have, in courtesy, given space to his long extract—that he should inform ourselves and readers what "he is driving at."]

Crude Petroleum Gas.

Office National Coal-Gas Company,
No. 4 Warren St., N. Y., Dec. 24, 1874.

Mr. Editor: In your note to the communication of Mr. Wren, in your last issue, you very properly say that "Many other of his statements (besides those referred to you) call for stronger support than bald assertion."

It seems to me idle to talk as he does, of making gas from *oil alone*, or to say that "What the consumer wants is a better light and more of it—not more gas." He overlooks the fact, that in order that a consumer may have "a better light and more of it" he must, of necessity, have *more gas, than oil alone* will furnish, unless expensive apparatus is applied to increase combustion.

Oil gas of 80 candle power cannot be used, except in very small quantities, with one-foot burners: the excess of carbon being so great, that from want of proper combustion it will smoke like an Esquimaux lamp. It is therefore absolutely necessary that it shall be *diluted*. To this end *air* has been injected. But air is a very bad element in gas—there is no chemical affinity between them. Their union is a mere *mechanical mixture*, and the nitrogen destroys the light and retards combustion.

What then is a proper diluent for over rich oil or coal gas? Why, evidently it should be *a gas* that has little or no carbon in itself, but possessing high calorific intensity. But, to be of the greatest profit, both to the producer and the consumer, the diluent should be a gas that can be made at the smallest cost: and this is a "*water gas*," produced under the Gwynne-Harris, or American Hydro-Carbon process, the patents for which are owned by this company.

I do not say of these statements, as Mr. Wren does of his, that "*I am ready* to prove them" But I do say, that we *have proved* them fully. Nearly 50,000,000 feet of gas have been made under our process: and now at this time the Citizens Gas-Light Company of Brooklyn, are sending our hydrogen through their oil tank, and making gas of 25 candle power. This is further reduced to about 18 candles by gas of low quality, from common bituminous coal, carbonized for the purpose of producing coke for fuel in the works. If the gas thus formed is too rich, all that is necessary is to send a part of the hydrogen directly to the main, and not through the oil. As soon as these gases unite there is a *chemical* union, and a perfect, uncondensable gas, of great brilliancy, is produced.

Oil gas will, of course, bear a far greater per cent of hydrogen than coal gas, because of its exceeding richness. But to the extent of 25 to 30 per cent. hydrogen will not reduce ordinary coal gas, but actually increase its illuminating power, by taking up the carbons that otherwise would be lost, and adding intensely to the flame.

Mr. Wren says: "Hydrogen alone or air would be of no use." I suppose he means for illuminating gas. But what does he mean by the use of either of them *alone?* Air as I have stated, is worse than useless in gas. But who has ever pretended that "hydrogen *alone*" should be used for light?

Again, he refers to my article in your issue of December 2nd, in which I quoted you as saying, that "it seems as if we should have to settle down for a cheap and effective dilution of our petroleum gas, upon that much scorned and maligned product "water gas." He then says, "In light of the above, why a diluent, when the gentleman confesses further on that he wants oil for an illuminator, shows also in the *Scientific American* of November 16th, the so-called Gwynne-Harris process, with a separate process for an illuminator, which is not comprised in either one of the Gwynne or Harris patents, but is a clean ap-

propriation of one of my patents." Your meaning seems to be very plain, that petroleum gas must have a diluent. But how my confession (even if I had made it) that I want "oil for an illuminant," logically raises his inquiry, "Why a diluent?" I am at a loss to conjecture. However I have stated why it is necessary.

As to the remainder of his remarks I will say. (1st) The *Scientific American* sent to the Works of the Citizens Gas Company of Brooklyn, without any knowledge or agency on my part, and examined our process, and the "separate process for an illuminator," which was there before our process was put in, and the result was the engraving and description of both processes, to which Mr. Wren alludes. (2nd.) We have never claimed that such "separate process for an illuminator," was comprised in either one of the Gwynne or Harris patents." (3rd.) Under our process, hydrogen and carbonic oxide gas is made by the decomposition of superheated steam, in the most perfect manner, and at the least cost ever before known; and every company purchasing the right to use it, can adopt whatever means they choose to give it illumination, whether by gas from coals, oils, or other substances rich in carbons. If the Citizens Gas Company of Brooklyn has appropriated one of Mr. Wren's patents for the illuminator they use, he knows where to find them. (4th.) In 1869 we sent our hydrogen through petroleum oil, and gave it splendid illumination. When did Mr. Wren secure the exclusive right to make gas from petroleum oil?

I will merely add that under our process, with 10 per cent. of oil, a greater amount of light can be furnished at 30 per cent. less cost, than can be obtained from oil alone, without smoking.

Respectfully yours,

H. P. Allen, President.

Heating Retorts with Coal Tar.

Knoxville, Tenn., Dec. 22, 1873.

Mr. Editor: I notice that the subject of heating retorts with coal tar, is receiving some attention at present in the Journal. I am induced thereby to give you some little experience I have had in that direction, with the hope that it may prove of some interest to your readers.

About twelve years ago I took charge of a retort house, in which there were two benches of fives (clay) heated with tar; the tar was conducted and supplied to the bench in the manner described in Mr. Nettleton's interesting communication, but without his appliance. In fact I do not yet see the necessity for such an appliance, as I never experienced any difficulty in regulating the *flow* of the tar, which ran in a fine thin stream, being kept in a pretty liquid state by the heat from the benches. But regulate the flow of the tar as I might—increase and diminish the size of the air aperture as I might, I was never able to keep up a good steady heat in those benches, especially in the lower retorts which, much to my annoyance, generally looked very bad. My opinion was then, and is the same now, that the tar will not give out the necessary amount of heat to keep up a bench of five retorts. I think the rush of cold air which seems necessary to effectually consume the tar, neutralizes, to a great extent, the heating power upon the retorts. Finally, after about twelve months trial, the tar-heating business was abandoned, and coke substituted, after which I had no more trouble. Respectfully,

James Somerville.

The Circulation of Water on the Surface of Our Enrth.

But, of what kind is the motion of water in the tides, a progressive or an undulatory one? The water of a stream flows, that is, the subsequent particles of water occupy the place which the preceding ones have left, as we see distinctly when a body floats on the water. Quite different is the case with the undulating sea. The ship does not drift forward on the crest of the wave, but merely rises and falls with it, without changing its place. If the wind blows over a grain-field, every blade yields to its pressure, to rise again afterwards. The waves advancing over the surface are therefore always formed by other blades. Just so the water alternately rises and falls successively at different places, and the succession appears to us a a lateral progress. The motion of water resembles that of the pegs inside of a piano set in motion by quickly running the hand over the keys. The wave-motion of the sea bears the same relation to a flowing stream as the propagation of sound to the wind; therefore the sea, even when in a state of most violent motion, cannot propel a water-mill, as little as by cannonading a wind-mill can be set in motion. Wave-motion and sound are both undulatory movements; the only difference, that in sound the particles of air are somewhat removed from the sound-producing body, and then return to their original place, while the water moves in a direction perpendicular to that of the wave. This up and down motion is therefore called a transverse undulation, that forward and backward motion a longitudinal one. What has been said of water refers, however, only to the short waves produced by wind, whose elevation, as compared with their transverse section, is considerable, but not to the tidal-waves, which appear very low when compared with their immense transverse section. The perpendicular motion of the former is no rectilineal one, but their predominantly vertical direction is accompanied by a small lateral one, which is manifested by the force with which a wave strikes against an obstacle in the way of its progress. This produces for the particles of water an elliptical movement, the major axis of the ellipse being almost vertical, and but little inclined forward, while the minor axis lies horizontally. In tidal-waves the particles of water are also moving in ellipses, but in very elongated ones, and the major axis of these ellipses lies horizontally. The tidal-wave therefore bears a greater resemblance to the motion of the particles of air in a sound-wave, than to that of the drops in a water-wave produced by wind. The undulation of water may therefore, at the time of the rising tide, be called a progressive longitudinal undulation, since the height to which the water rises is inconsiderable as compared with the lateral motion, which appears as an ebbing and flowing current.

If the earth's surface were everywhere covered with an equally deep ocean, a very broad double wave would perform its journey around the earth from east to west within 25 hours, and such a wave would attain its highest elevation at the equator, while at the poles it would be completely flattened. This is approximately shown in the Southern ocean, where the wave is for a great distance unobstructed by land. But the phenomenon essentially changes its character in the Pacific, the Indian, and the Atlantic ocean. In each of these oceans a new tidal-wave always begins at the eastern, and is reflected from the western shore, before another primary wave has been formed. If we draw a violin bow across the edge of a plate of glass, the bow, gliding along this elastic plate, causes indentations which progress as waves over it, and return reflected from the other edge. The more regular the intervals are in which the plate is excited to motion by the bow, the more regularly the advancing and returning waves meet, and the progressive undulations are soon converted into a stationary one, in which all parts of the plate vibrate simultaneously around their average level. If we compare the tide-producing luminaries, the moon and the sun, with the bow, and those great ocean basins with the elastic plate, it does not seem improbable that at last this broad mass of water is set into an undulatory motion, similar to that of the water in a glass which is rapidly pushed to and fro on a table. As the water in such a glass rises and falls the most at the edge, while changing its elevation least in the centre, so the ebb and flow of the tides will be stronger at the shore than at an island in mid ocean. After having for a long time only inquired how the ebb and flow of the tides would appear on an equally deep sea surrounding the whole earth, and after having theoretically answered this inquiry, investigators have recently taken another step in advance by trying to establish by experiment and investigation how the phenomenon appears on the actual ocean of the earth. This has brought to light the fact that the high tide in America indeed comes from the east, but in Africa and Europe from the west. If the tidal-wave penetrates into a narrow bay, it rises higher and higher; but on its course towards a large island it may possibly be so delayed that it arrives only when another part of the wave has commenced to ebb. As on the sounding glass-plate, amid the similar encounter of the elevations and depressions of a wave, lines of rest occur in which the vibratory motion is neutralized, so there is a place in the North sea where the waves entering through the English channel, on their meeting the great Atlantic tidal-wave on its descent along the coast of Scotland, completely neutralize the rising of the tide. The grandest accumulation of water, in connection with the motion of the tides, is found in America, in the Bay of Fundy, at the head of which the difference in the water-level sometimes amounts to 100 feet. If the tide were to rise to such a height in the Baltic, Berlin would sometimes become a sea-port, for the pavement of Dorothea street, near the old observatory, is exactly 100 feet above the water-mark in Swinemunde. But the Baltic is so cut off from the Atlantic by Denmark, that the inhabitants of Mecklenburg discovered only a few years ago that they had an ebb and flow, though of but a few inches. How grand, on the contrary, is the phenomenon on the western coast of Europe. We hardly believe our eyes when we see the children play on the dry sand at Ostend, where six hours afterwards people are bathing; or, on seeing from Bristol cliffs a dog wading through the river to the place where the omnibuses are waiting to receive the passengers who land here from the steamer; or, on finding on the railroad from Chester to Anglesia the wide bay of the Dee perfectly dry, where, on our return six hours later, we behold from the Britannia bridge proud three-masters riding; or, on taking a walk around Heligoland during low tide without wetting our feet, where during the high tide, the surf breaks thundering against the rocks.

The descent of the Scandinavian mountains towards the sea is so steep that their lateral valleys are filled by the sea, thus forming the Fjords. Here, at the time of ebbing tide, the water flows out with so violent a rush, that it has been said, with some exaggeration, that Norway is a country where the ocean forms waterfalls. But, although they are not actual waterfalls, yet they are dangerous whirlpools, of which the maelstrom is the best known.

What is the result of this restless work? Its effect is most perceptible in the Polar sea, in the uninterrupted destruction of the ice-masses, whose pressure at the time of high water even the strongest vessel is often unable to resist; but by this very fact accesses are opened into this region, which is otherwise closed by an impenetrable wall of ice. Along our coasts the effect of this work, continued through thousands of years, is likewise perceptible in the sand of the sea. If we calculate the value of labor which is required to grind down solid blocks of rock into sand, what stock company would undertake to furnish only the small quantity of sand upon which Berlin is built? The cause of this immense mechanical effect lies in the fact that waves produced by the wind are only superficial, while the tide-producing force extends over the entire mass of water. With a tidal wave of an elevation of three feet at the equator, which were to diminish at a regular rate up to the poles, 200 (geographical) cubic miles of water would, within six hours, be carried from one quarter of the earth to the other. Although this is an insignificant quantity in comparison to the entire mass of water on the earth, which, according to Herschel, amounts to 1-1766 of the mass of the earth, yet the force required for setting such a mass in motion, and carrying it through such a space, is very considerable, if we bear in mind that a cubic foot of water weighs 66 Prussian pounds. But, how

high must the tides have been when the entire earth was yet in a liquid condition? We could not wonder if, in the primitive crystalline rocks everywhere the traces of violent destruction were found, even in those places where they have not been crowded into the stratified layers of other destroyed rocks at a later period only. But, necessarily, these traces will be found most distinct in the equatorial regions, because there, under the vertical influence of the luminaries upon an entirely liquid earth, the tides must have been greatest.

Whether the interior ocean, which is in a state of liquid incandescence, also forms tidal-waves, or whether it is too tenacious for such a motion, we do not know. Like the external ocean on the shore, it perhaps crowds and destroys the solid crust, along which we often distinctly perceive the progress of waves, which we call earthquakes. This crust is certainly pliable. Does not Sweden slowly rise before our eyes from the sea, which, continually recedes from its shores, while along the coast of Pomerania no such change is visible? Does not the land sink down in other places, as, *e. g.*, in Istria, where R man pavements are found under the present level of the sea? Has not Darwin even shown it to be probable that the tradition of a submerged Atlantis is realized on a large scale in the Pacific, where the great Australian coral-reef, which once no doubt touched the shore, now at a distance of many miles from it, repeats in an extent of many hundred miles, in a large arc, the contour of the coast, and where hundreds of circular coral reefs, with lagunes in the centre, still indicate the extent of islands which were long years ago submerged, while the coral insects still industriously continue to build on the sinking foundation, to remain in contact with the surface of the sea? Their activity is only limited, and the whole structure becomes a dead mass of rock where the bottom of the sea rises and finally is laid dry, of which so distinct traces are found in the Jura mountains and their continuation, extending like a rampart from the south-west boundary of Switzerland to near Baireuth.

[To be continued.]

Hall's "Pulsometer."

Regarding this form of pump, *Iron* throws out the following interesting remarks: "The American inventor seems never to be at a loss either to produce something new or seemingly new, or to confer upon his productions some striking or high-sounding name. An instance of this is found in the mysterious-looking contrivance we illustrate herewith. In shape entirely new, in principle altogether old, this "magic pump," as it is called, can by no effort of imagination be assigned to its proper use. Yet the thing is sufficiently useful to be employed in mines, ships, and other places where water must be raised, and to keep a factory going in its production: while the id a is deemed valuable enough to justify the taking out of no less than thirty patents, which all combine to protect this one contrivance. This pulsometer is noteworthy on more than one account. It furnishes, for instance, a remarkable illustration of the way in which inventions repeat themselves. Here we have identically the same idea as that of Savery's first pumping engine two centuries ago—alternate suction and forcing in the same chamber. Savery's hand-worked cocks and levers are here most ingeniously replaced by self-acting bullet valves, the small steam valve at the top deciding the action by being placed upon a sharp bridge, like the soul of a Mahommedan sinner, where it cannot possibly rest, and must therefore of necessity fall to one side or the other, the open passages alternately closing themselves by the rush of steam, and its subsequent condensation in the water chamber."

Propagation of Cholera by Fruit and Water.

French *sacants* are beginning to look upon the theory of the propagation of cholera by invisible germs conveyed in the air, or water, as an established fact. M. Charles Tellier, a French *sacant*, in taking this theory as demonstrated, makes some suggestions which are worthy of consideration. He placks no great reliance in the effect of antiseptics upon the air itself, their action being, to say the least, doubtful. Moreoxer, he considers the action of the germs unavoidably taken in respiration as comparatively innocuous, because those taken in the lungs do not reach the intestines, and because such as are thus swallowed, being taken as it were in small quantity at a time, the vitality of the system is able to resist their action, in like manner as it overcomes the action of peison taken in insignificant doses. But it is by introduction of the germs into the alimentary canal, where they find conditions altogether favorable for their rapid multiplication and development, that the disease is most frequently and most fatally communicated. Fruits are spoken of as being especially calculated, some by their downy covering, as the apricot or the peach, others by the gummy or glutinous coating which most of them possess, to arrest and retain the germs carried by the air. It results that one partaking of fruit freely, and without precaution, may take a considerable quantity of the infectious germs directly into the intestinal canal, where they are most likely to produce mischief.

M. Tellier recommends that, during the prevalence of epidemic cholera, the people be instructed to confine themselves to cooked fruits, or, if they will not deny themselves the use of raw fruits, to eat them only after careful washing, or, better still, the removal of the skin.—*Scientific Press.*

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FRIDAY, JANUARY 2, 1874.

WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

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CONTENTS.

☞ An asterisk (*) denotes an illustrated article.

Farmer's Patent Dumping Barrow..... 1
Heat and Light..... 1
The Ellis Vapor Engine..... 1
Chesebrough's Scheme..... 2
A Simple Fire Alarm..... 2
Chemical Excerpts..... 2
The Manuafcture of Gas from a Mixture of Tar-Oil and Dross..... 3
Some Notes on the Chemistry of Gas Manufacture..... 4
A Sad Case..... 5
CORRESPONDENCE—
Com i ation of Hydrogen Gas and Carbon..... 5
Crude Petroleum Gas..... 5
Heating Retorts with Coal Gas..... 6
The Circulation of Water on the Surface or Our Earth..... 6
Hall's Pulsometer..... 7
Propagation of Cholera by Fruit and Water..... 7
EDITORIALS—
1873..... 8
Gas Engines..... 9

1873.

The year that has just elapsed has witnessed symptoms of activity, or at least of efforts in the direction of progress, in gas matters, beyond many of the years immediately preceding. It will be in order for us, and of undoubted interest to our readers to skim, over some of the things that have been done and begun, during the last twelve-month.

Probably the most important subject, and one which has attracted prominent attraction on both sides of the Atlantic is that of charging and drawing retorts by machinery; and in this country two grand inventions, emanating from two of our most distinguished inventors, have been placed before the public. These are the plans of Messrs. Rowland and Havens, of both of which we have seen working models, and have illustrated them in our columns. Mr. Havens's, indeed, is not a model, but an actual machine—of life size, so to speak. It was exhibited at the late American Institute fair, though not mounted so as to be put in operation there. Mr. Havens claims for his invention that it is equally adapted even for the smallest works, and requires no alteration of existing benches or buildings, or any other plant; that it is cheap, and requires no more room for its work than the men it supplants. These, if confirmed, in practice, as we believe they will be, are points of paramount importance. In England there is a new invention also, of this class, by Mr. Mann, of London (see last volume, p. 117) which doubtless deserves examination.

Different modes of temporarily abolishing the hydraulic seal upon the exit pipe from the retort during the carbonization of a charge, continue to be experimented on. New results have, we believe, been obtained by the Gibson and Jones plan, but we have no details as yet. The McIlhenny method stands prominent among these plans, and striking facts resting upon the personal observation of the Editor, at Portland, Maine, were presented at the beginning of the past year. It was found that Mr. Yorke of Portland gets by this method from a mixture of half and half Youghiogheny and an inferior Despard, enriched slightly with four and a half per cent. grahamite, a volume and candle-power reducible to the equivalent of five and one-third feet per pound, or 11,950 feet per long ton of 16-candle gas. Other surprising figures were given, and the writer does not see why so little attention has been drawn to this important matter.

Among the subjects of importance connected with increase of consumption of gas, that of gas-motors for small powers is now receiving some notice, from American inventors as well as abroad. To-day we refer especially to this subject in another article. As regards the French machines of Fontaine (referred to on p. 119 of the last volume), costing, as stated, for one-man power about a quarter dollar per day, we have met with nothing further as yet.

In cooking and heating by gas, we have had several treatises of great value on these subjects, including the paper of Mr. Hartley, read to the British Association of Gas Managers last June, Mr. Cathels's new and elegant little book (for sale by the publishers of this Journal) and others. What appears called for in this direction is the introduction into this country of the highly improved devices and models, of heaters and cookers, which are now so familiar in England.

In our own individual case, we use largely, for domestic purposes, both for heating water and for warming rooms, the ordinary plain Bunsen burners, in the new and improved form (American, we believe) now being introduced into chemical laboratories, which contains a cylindrical valve at the base of the column, by means of which the gas and air are turned off or regulated simultaneously; and in which therefore the flame does not recede and burn internally, with a stench, wherein has been the objection heretofore to the atmospheric burner in all its forms. We cannot insist too often or too strongly on the fact that gas cooking and heating is of the greatest importance wherever labor is dearest, as in this country. Its saving here is greater in labor than in all else put together. Convenience, safety and comfort (both of mind and body) are destined to result from gas-fuel, to an extent which would justify its introduction, were its cost far greater than it is.

In processes of purification of gas, we have had published, during the last year, for extracting the last remnants of sulphur, which are left by both the lime and iron processes, in the form of bisulphide of carbon, and probably also in those of sulphuretted hydrocarbons, and mercapatans or sulphur-alcohols, the methods of Patterson, which will doubtless occupy much of our attention at a future day; also that of Vernon Harcourt, by passing the gas over metallic iron heated to redness, the latter method seeming, so far as we are informed, rather problematical, as regards both novelty of principle and economy of application.

Mr. Harcourt has also brought out another new method, or rather improvement in ordinary iron-purification, in a paper read to the British Association for the Advancement of Science last summer (see our last vol. p. 188), consisting in moistening the fouled iron-oxide during revivification, with a solution of sulphate of iron, which is then converted by the ammonia of the gas into sulphate of ammonia, setting free some oxide of iron. A portion of the mass is removed at each operation and the soluble salts, etc., extracted. It is claimed that the iron is thus prevented from ever becoming so clogged with free sulphur as to lose its activity.

In connection with this we may throw in a word respecting the subject of Ammonia-Saving, which is not practised as it deserves to be. Mr. Smedberg of San Francisco has given great attention to this point, and announced some time since that he intends embodying his results in a paper on the subject, in which, as we are told, he will prove that this waste product may be made to pay, even in this country, at the rate of half a dollar per ton of coal carbonized. We trust we may still look for this highly important contribution from Mr. Smedberg.

In connection with Purification, we may also refer to the Mechanical Condensing and Scrubbing arrangement recently patented by two Frenchmen, Pelouze and Audouin, about which much noise has been made; the principle of which is to produce much intestinal motion in the gas and bring it thus into contact with largely extended surfaces, moist or otherwise. It appears now, that besides American claimants to priority in this kind of condensation, of which we have shown one case, and could now indicate others, there has been one on record in France itself as much as 18 years. Colladon, the Gas Engineer at Geneva, Switzerland, used this method there in 1856, as well as shortly after in Naples and Rome, and patented it in France. Another case of the puerility of patent systems parti ularly in European countries) according to which the public—to which inventors look for support—can have no assurance of the novelty

of principle of a patent in the market until it has come into use and has been brought into the courts, where an investigation must be entered into that should have been made before the issue of the patent. The practical working of the present system is in reality to hold out a bonus to bogus, and factitious patents covering sometimes little more than a new form of words cooked up to convey an old idea, as against real scientific inventors who devote their lives to preliminary training, know all that has been done before by others, and commencing from this only true stand-point, labor to explore new paths.

Not that we have any idea of assigning Messrs. Pelouze and Audouin, however, to the class of sham inventors. They belong, without doubt, to another large class of well-meaning inventors who have the capacity to carve out new paths, but unfortunately neglect to inform themselves thoroughly, in advance, as to what has been done before by others. Men of this stamp are themselves, with the general public, victims of the organic imperfection and maladministration of patent codes.

During the past year much has been done in the way of development of the amazing resources of our country in the way of gas coals. The Ohio and Chesapeake Railroad has gone into operation through from the West Virginia coal-fields to tide-water, and a new channel of supply is thus afforded not only to some of our own domestic, but also to a multitude of foreign markets. But five years since, the "bragging Yankee" who should have prognosticated that our children would see an exportation of gas or other coals from America to Europe would possibly have been tolerated at home, but poohpoohed with disgust abroad. The whirligig to time, however, is very swift just now. We shall ourselves see this revolution, and very soon, and probably sooner in the case of gas than other coals. The new opening to the sea-board we have spoken of will soon bring this about.

There are, however, other movements going on, of much greater importance to our own internal commerce than this one. One that we have particularly in our mind at this present writing is the rapidly increasing developments that are now beginning upon the *western side* of our great Allegheny coal basin. Until within a very few years, the great mass of our gas coals, even for the western markets and the Mississippi valley, has been drawn from the eastern side of this basin, from points east of Pittsburgh. The fact is only just now gradually being generally recognized that in extreme western Pennsylvania and eastern Ohio, there are large tracts rich in valuable gas coals, which will be mined and distributed over an immense area of the United States and the Canadas, including the whole of the country west of the Alleghenies.

Our subject is spinning out, however, too much for this issue, and this and some further points belonging to the developments of 1873 must go over.

GAS ENGINES.

This is a topic which we are certainly not mistaken in asserting, in the halcyon days of gas in America, which, in our optimistic moods, we look forward to (not too *far* forward we trust)—will not fail to occupy, and reward, the careful attention of the profession. It appears that at the Vienna Exhibition there were several gas engines exhibited; an account of one of which was condensed in the last issue (Excerpt No. 927, page 187; see also Oct. 16, page 133), that of Otto and Langen.

[It is well to introduce here a correction of a statement in a former editorial on this subject, in issue of the 2d of July last, page 8. We there quote Prof. Thurston as comparing his experiments upon the new American Brayton engine, with experiments made in Paris on the Hugon engine, as showing 18 per cent. less gas-consumption in favor of the Brayton apparatus. On reading Professor Thurston's report with more care, it appears that the Parisian experiments were really made with Otto and Langen's engine [referred to in our last], and Prof. T. quotes experiments with the Lenoir and Hugon engines which fall very far behind the Otto and Langen. At the same time he remarks of the latter that it is "an impractical form of engine, quite valueless for general work, and is unmechanical in design and noisy and irregular in action."]

Considering the remarkable results of Professor Thurston with the Brayton machine, which, as Professor Silliman says (in his letter quoted by us June 16, 1873, page 207), should cost for one horse-power for three days, or three horse-power for one day, less than 1,000 feet of gas, it is *very* remarkable that we do not hear more of it. The reticence which is maintained, at least towards this Journal and the Gas Profession, is extraordinary. No power on earth could exert a tithe as much influence, or could have a tithe as much interest, as the Gas Profession, in bringing into use an invention realizing the advantages claimed for this one. It is true, it has come to the ears of the Editor of this Journal, that some investigations *were* made by a Committee of three Engineers (not of the gas profession, however, we think) upon the Brayton engine exhibited at the American Institute Fair in this city; but, so far as we are aware, no results have yet been published. What can the matter be?

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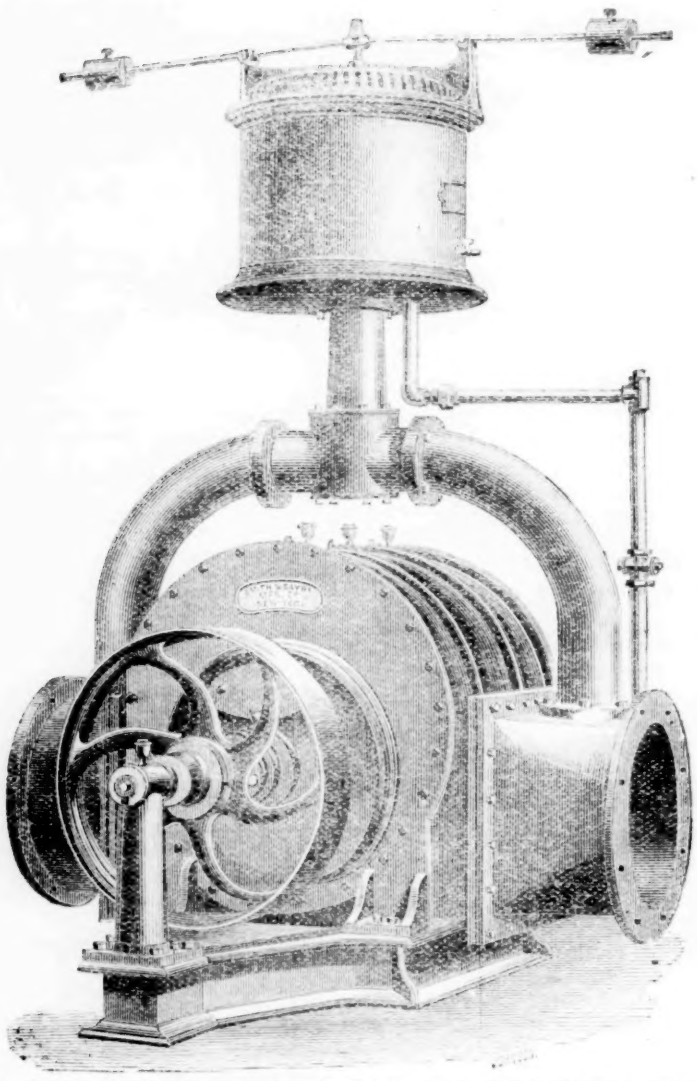

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JAMAICA PLAINS, MASS., June 21, 1871.

EDWARD DUFFEE, ESQ.

Dear Sir; The Trays ordered by this company three years ago, are getting somewhat worn. I wish to say here that I consider your Trays to be superior to any yet invented, therefore please make us another set at the price named, to be like the sample shown in every way, and oblige Yours truly
JAMES F. ROGERS,
Sup't Jamaica Plains Gas-Light Co.

BROOKLINE, June 11, 1871.

E. DUFFEE, ESQ.

Dear Sir: You will please make a set of Gas Trays for this company as soon as convenient, at price named. In regard to the merits of the Tray, after having them in constant use for over two years, I will say that I consider them *superior to any Tray* manufactured in this country. Respectfully yours,
H. A. ALLYN,
Sup't Brookline Gas-Light Co.

BANGOR, August 2, 1870

EDWARD DUFFEE, ESQ.

Dear Sir: Yours of the 20th ult. is received. In regard to your Gas Trays, I take pleasure in saying that they have been in use over two years, and have given perfect satisfaction and they are in good order at the present time; should have no hesitation in recommending them, believing they are the most durable and easiest kept in order of any with which I am acquainted. Respectfully yours,
W. H. PERRY, Sup't.

OFFICE OF THE SPRINGFIELD GAS-LIGHT Co.
SPRINGFIELD, MASS., Oct. 10, 1871.

MR. WARD,
President Hartford Gas-Light Co.

Dear Sir: I have been using Gas Screens made by the American Gas Screen Company, for nearly a year, and find them superior in every way to the wooden Screens made and formerly used by the Springfield Gas-Light Co. I can purify more gas with the same quantity of lime, there being more surface to the Screens; and I consider them more durable, and recommend them to your consideration.

Yours with great respect,
GEORGE DWIGHT.

ROXBURY, June 14, 1872.

EDW. DUFFEE, ESQ.

Dear Sir: In answer to your inquiry regarding your Patent Gas Screens, I am happy to be able to say, that after nearly three years constant use we are perfectly satisfied with them being able to purify over fifty pet cent, more gas with them, than with any other Screen we have used.

Yours respectfully,
THOMAS J. PISHOU

OFFICE DETROIT GAS-LIGHT Co.,
DETROIT, MICH., April 22, 1872.

AMERICAN GAS SCREEN MANUFACTURING Co., HAVERHILL.

Gentlemen: The Screens bought of you work far better than any we have ever used. As a proof, we have with the same quantity of lime purified *twenty per cent*, more gas with your Screens than with any others, and the work well done. The workmen are also better pleased with them—they being light and handy to work. They also relieve the pressure very much upon the retorts, and I cheerfully give yau my experience.

Yours truly,
P. E. DEMILL, Secretary.

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Amer. Gas Screen Man'f'g Co., Haverhill, Mass
EDWARD DUFFEE, Agent.

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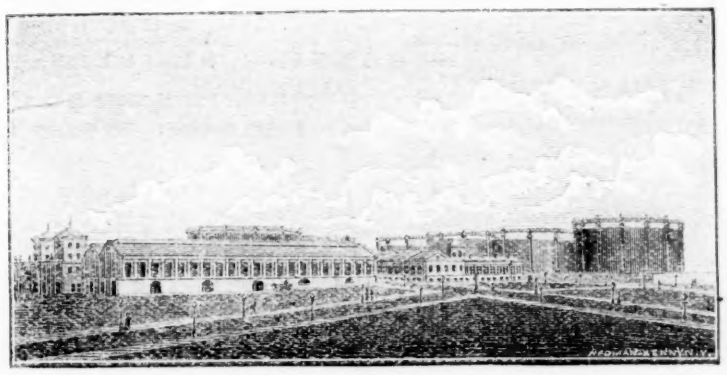
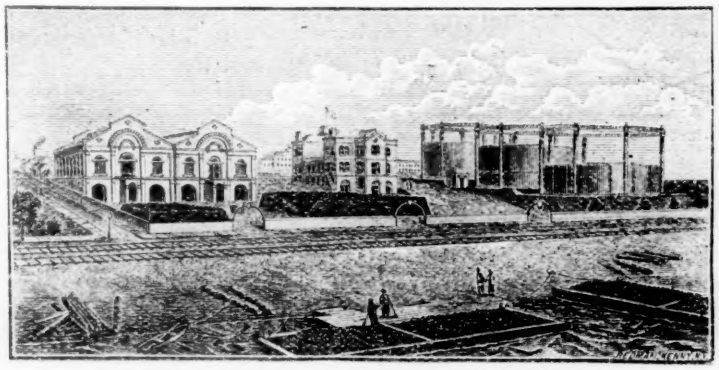
REFERENCE.—RICHARD MERRIFIELD, Esq., late Vice President MANHATTAN GAS-LIGHT COMPANY.



CINCINNATI GAS WORKS, ERECTED 1871-72-73.—WM. FARMER, ENG.



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Cost 70 cents per bushel. One bushel for each square foot of Purifier sufficient. Rights to use for life of Patents, for daily makes of gas in thousands; under 25,000 $200; under 50,000, $400; under 100,000, $500; $250 additional for each additional 50,000 per day.

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☞ Immediate arrangements are urged, as the demand for e prepared composition is increasing *so rapidly* that delays supply may occur.

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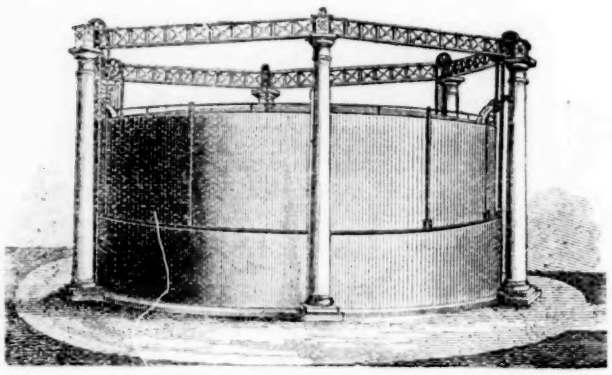

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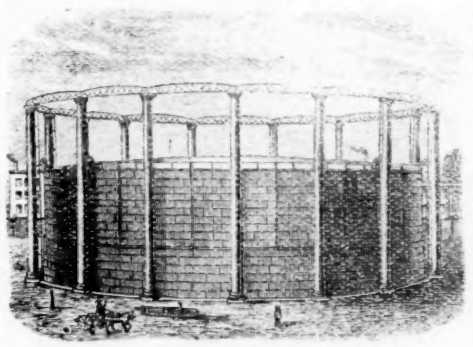

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252-1y

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It yields 10,996 cubic feet of gas to the ton of 2,240 lbs. of good illuminating power, and of remarkable purity; one bushel of lime purifying 6,792 cubic feet, with a large amount of coke of good quality.

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The best dry coals shipped, and the promptest attention given to orders. 234-1y.

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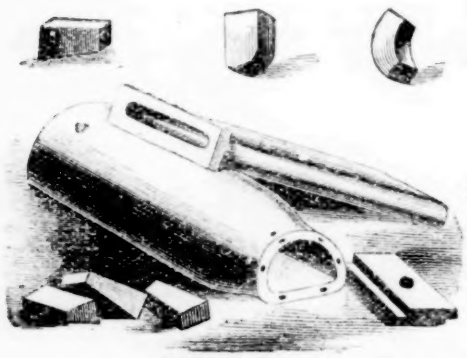

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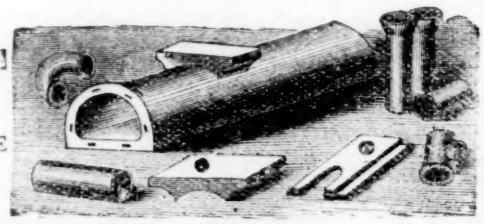

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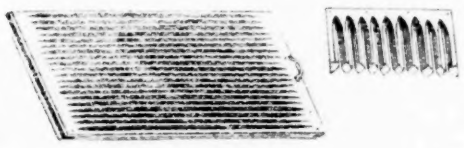

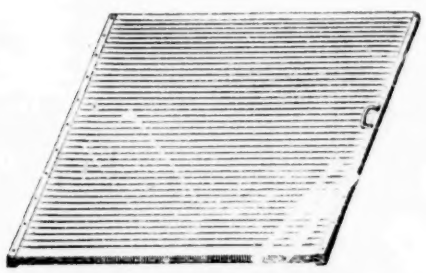

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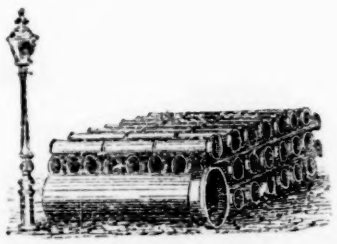

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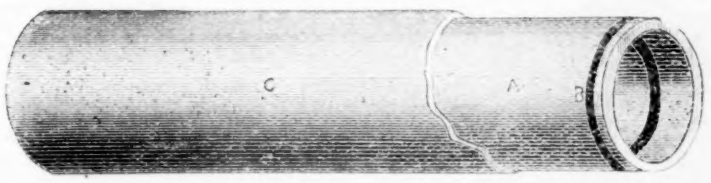

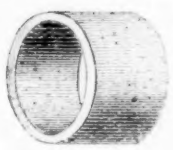

FIG. 2.

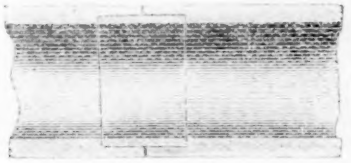

FIG. 3.

A—Cylinder of Wood. B—Band of Iron. C—Coating of Hydraulic or Asphaltum Cement.

FIG. 2.—Thimble for Connection. FIG. 3.—Horizontal Section and Connection.

Above is a cut of the

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This Pipe is made of White Pine, one inch to sixteen inches bore, in sections eight feet long rounded in a lathe, coated inside and out with Asphaltum, connected with a tenon, or socket, and a thimble joint, perfectly air and water tight, being driven together with cement furnished by the Company. When laid its cost is about one half that of Iron Pipe, and is UNQUESTIONABLY the best Gas conducting Main in use.

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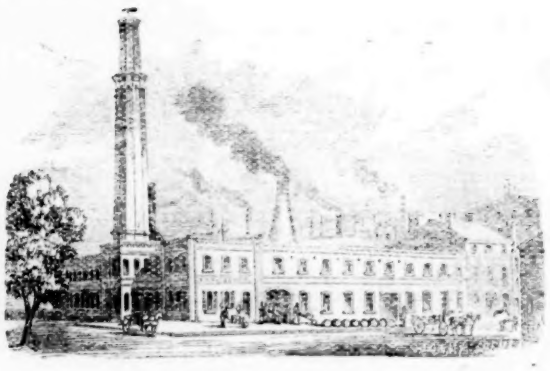

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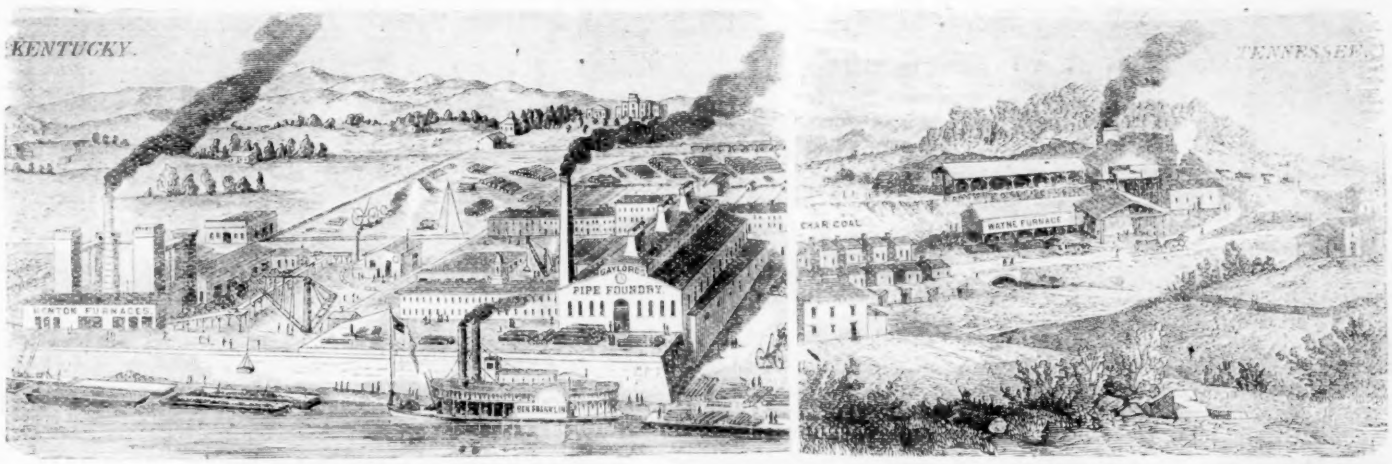

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But the extraordinary results obtained by the McIlhenny process, have induced some unprincipled persons to bring to the notice of the public, as *recent inventions of their own*, some of these old devices; their purpose seems to be simply to evade the patent.

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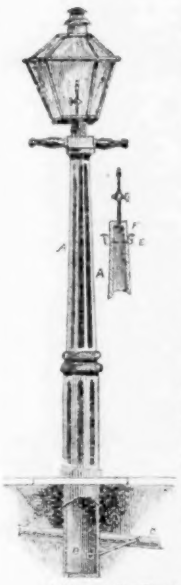

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CONDENSERS.—Single and Multitubular Air and Water Condensers.

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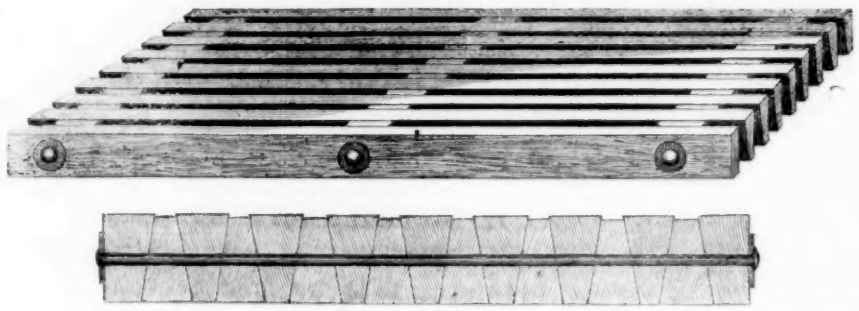

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St. Paul Gas-Light Company, Minn.
Cumberland Gas-Light Company, Md.
Hartford City Gas-Light Company, Conn.
Richmond Gas Company, Va.
McKeesport Gas Company, Pa.
Middletown Gas Company, Pa.
East Newark Gas-Light Company, N. J.
Binghampton Gas Company, N. J.
Zanesville Gas Company, Ohio.
New Orleans Gas Company, La.
Salem Gas-Light Company, Mass.
New Britain Gas-Light Company, Conn.
Rahway Gas-Light Company, N. J.
Trenton Gas-Light Company, N. J.
Elmira Gas Company, New York.
Erie Gas Company, Pa.
Columbus Gas-Light Company, Ohio.
Westchester Gas-Light Company, N. Y.
Santa Cruz Gas Company, Cal.
Lawrence Gas-Light Company, Kansas.
Salem Gas Company, N. J.
Indiana Gas-Light Company, Pa.
Peoria Gas Company, Ill.
Montclair Gas Company, N. J.
Williamsport Gas Company, Pa.
Wooster Gas-Light Company, Ohio.
Augusta Gas-Light Company, Ga.
Huntsville Gas Company, Ga.
Chattanooga Gas Company, Tenn.
Murfreesboro Gas Company, Tenn.
Hagerstown Gas-Light Company, Md.
Hanover Gas Company, Pa.
Easton Gas Company, Pa.
Uniontown Gas-Light Company, Pa.
Coatesville Gas-Light Company, Pa.
Houston, Gas Company, Texas.
Wilkesbarre Gas Company, La.
Middletown Gas Company, New York.
Washington Gas-Light Company, Pa.
Princeton Gas-Light Company, N. J.
Newark Gas Company, Ohio.
Pontiac Gas-Light Company, Mich.
And numerous other Companies.